2025.2

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Of the Variation of the Compass,

The Variation of the compass is an arch of the Horizon contained between the meridian of the place & the magnetic meridian, & is either East or West, or it is the number of degrees &c the needles point stands from the true N. or S. points of the Horizon, reckoned to the Eastward or Westward, & is easily found from the Suns amplitude or Azimuth,

To find the true Amplitude

The Suns true Amplitude is an arch of the Horizon, comprehended between the true E or W points there of & the centre of the Sun at its rising or setting; or it is the number of Degrees, &c the Sun rises or sets to the N or S. of the East or West points of the Horizon.

The Suns magnetic Amplitude is the number of degrees &c the centre is N or S. of the East or West points of the compass at his rising or setting & is found with an Azimuth compass in the manner following Viz —

Having placed the azimuth compass in a convenient part of the ship, look directly through the sight vanes at the Suns centre; & when the Suns lowermost edge just touches the ~~master~~ horizon stop the card, (by a stop which is placed on the compass for that purpose;) then the quantity of degrees & minutes contained between the E or W, & the N & S, points of the compass will be the magnetic Amplitude — The true Amplitude is found either by inspection in the tables of the Suns amplitude or by calculation —

turn over —

Rule, As the sine complement of the Latitude

Is to radius

So is the Sine of the sun or star's declination

To the Sine of the true amplitude:

Which is always of the same name with the declination.

Or to the secant of the latitude (rejecting the index) add the log sine of the sun's declination, the sum will be the log sine of the true amplitude.

Note. The arithmetical complement of the co sine of any arch is always equal to the secant of that arch, throwing away radius, or neglecting one, which stands the first figure in the secants index; likewise the arithmetical complement of the sine of any arch is the co secant of that arch less radius, or the first figure of its index: Wherefore the Arithmetical complement of the sine or co sine of any arch is found in the table of secants by inspection

Examples

On the 21st October 1800, in latitude 51° 32 N; I demand the true amplitude

As Sine comp lat 51°32 =	9.79383	Or Thus	
Is to radius ———	10.00000	Lat 51°32 N Sec	0.20617
So is Si sun's dec 10°43S =	9.26940	Dec 10 43 S log sin	9.26940
To Si of true amp 17°24'S —	9.47557	True amp 17°24' S	9.47557

In lat 38°25 N. Declination 18°59 N. what is the true amplitude

As Si comp lat 38°25 =	9.89405	Or Thus	
Is to radius	10.00000	Lat 38°25 N Sec	0.10595
So is Si sun's dec 18°59 =	9.51227	Dec 18 59 N Sin	9.51227
To sun's true amp 24°32 N.	9.61822	Sin 24°32 N. true am.	9.61822

To find the true Amplitude by the Table of Amplitudes.

Look for the given declination at the top of the table, & the latitude in the first column of the left hand, in the common angle of meeting will be the degrees & min of the amp. required. But when the latitude is given in degrees, & the declination in degrees & minutes, find the declination at the top as before, & the nearest degrees to the given latitude in the left hand column, against which & under the given declination, stands the true amplitude; or if the minutes of the declination be near 30, or half a degree find the Amp for the given degree & the next one above it. add these two Amplitudes together, half their sum will be the true Amp sufficiently exact for sea use — —

Suppose I would know the Suns true Amp at his setting in latitude 57°. his declination being 11° 33' S —

Find the amp as before for 57° & declinations { 11° / 12° } which will be { 20° 29 / 22 25 }

Sum 42 . 44

Half Sum 21 22 is the True amplitude — — —

That is W 21° 22' S because at setting & the declination South, In like manner if the declination be in degrees & the latitude in degrees & minutes — as

Suppose it were required to find the Suns true amplitude at setting in lat 49° 27'. when his dec was 21° N —

For lat { 49° / 50' } & dec 21° { 33° 6 / 33 52 }

66 58

½ Sum — 33 29 that is W. 33° 29 N —

Having found the Suns true amplitude by the Preceding methods & the magnetic amplitude or azimuth by observation, it is evident, that when they agree there's no variation; but when they disagree, then if the true & observed amplitudes be both of the same name, that is both N or S — their difference is the variation — but if of contrary names their sum is the variation —

Again, if the true & observed azimuths be both on the East or both on the West side of the meridian their diff^{ce} is the variation, but if on different sides of the meridian their sum gives the variation; & to know whether the variation be Easterly or W^{ly}, observe this general Rule. Let the observers face be turned to the Sun: then if the true amplitude or azimuth be to the right hand of the magnetic, or observed, the variation is E^{ly} but if to the left WS^{ly} —

Suppose the Suns magnetic amplitude at rising is E 26° 12 N, but the true is E 14° 20' N required the Variation

From Greater E 26° 12 N

Take Lesser E 14 20 N

remains varia-11 5-2 E because to the right of the Obsv

Double Altitudes

The method of finding the latitude at, by taking two altitudes either in the fore or afternoon, having the intermediate time measured by a common watch, with ease & accuracy, independant of the suns meridian altitude

General Rules

1st To the log secant of the latitude by account, add the log secant of the sun's declination, (rejecting the indexes) & call the sum the logarithm ratio.

Note. The Arithmetical complement of the co sine of any angle is equal to the logarithmic secant of that angle omitting the first figure in the index: Thus, the sec^t of 46°50' is 10.16487, & omitting the first figure 1, leaves 0.16487, the sec^t less radius or the arithmet-icall complement of co sine 46°50' —

2d From the Natural sine of the greatest altitude, subtract the N Si of the least alt. find the log of their difference, & write it under the log ratio —

3d When the altitudes are both taken before or both afternoon, subtract the hours & min, when the altitudes were taken from each other, & half the diff call half elapsed time; but when one is taken before & the other afternoon, half the sum of the times from noon is the half elapsed time —

4th With half the elapsed time enter the tables, & from the column of half elapsed time take out the log answering thereto, & set it down under the log ratio —

5th Add these three logarithms together, & with their sum enter the tables in the column of middle time,

where —

In the former example we have considered both altitudes taken at the same place or station; but as it seldom is the case at sea the necessary correction for any alteration of station may be readily made as follows

Suppose the first alt in the forenoon at	10h	26
The second alt in the afternoon at 2h 43m	14	43
Diff Long made is 30m W equal to		2
	14	41
	10	26
Subtracted is the elapsed time	4	15

A Ship sailing NE ½ E by compass at the rate of 9 knots per hour at 0h 31m 40sec PM per watch. I found the altitude of the Sun's Lower limb 28°20' above the horizon of the sea, the eye being elevated 20 feet above the surface of the water & the Suns bearing by compass being at the same time S BW, & at 2h 58' 20" PM per watch the altitude of the Sun's lower limb was 16°41 above the horizon the eye being elevated as before & the latitude by account at the time of the last observation was 28° 00' N & the declination 13° 17' S. Required the true latitude at the time of the last observation

Correction for the first altitude.

The time of the first observation 0h 31m 40" PM. the second 2h 58m 20" PM so the elapsed time is 2h 26m 40 sec & the rate of sailing is 9 miles per hour - Then as 1h : 9m :: 2h 26m 40sec : 22 miles the dist run in the elapsed time. Again The Suns bearing at the first observation is S BY W. the opposite point to which is N BE - or 1 point The Ship course during the elapsed time is NE ½ E or 4 ½ pts

So the angle of the Ships course with the Suns bearing is } NE ½ N or 3 ½ pts

3/2 pt course 22m dist gives 17m D lat. which is to be subtracted from the first obsvd alt=

First obs alt Suns L Limb	28°	20	Secd	16°	41'
refraction to be subtracted		2			3
Correction for refractn	28	18		16	38
Dip of the horizon subtd		4			4
Appt altitude	28	14		16	34
Suns Semidiamtr addd	"	16		"	16
Corrt alt Suns centre	28	30		16	50

Suns 1st obsd alt 28° 30"
Sub 17
corrt alt 28 13

Lat 48° " sec 0.17449
Dec 13 17 0.01178
log ratio 0.18627

Times			alt	N S
h	m	sec		
0	31	40	28° 13' =	47281
2	58	20	16 50 =	28959
Eld T	2	26	40	Diff N S 18322 its log — 4.26297
pEd T	1	13	20	its log from col ~~for Eclaptime~~ — 0.50232
	1	46	30	in ortmid time corresp^d to 4.95156
		33	10	its log from col rising 3.01923
		31	40	log ratio 0.18627
error of watch	1	30		681 Num of 2.83296

N Si gt alt 47281
47862 N Si mer alt

28° 40 equal to

Zen Dt 61 20 N
13 17 S

Lat 48 3 N agreeing within 3' of the lat by account it may be taken as a true latitude. Thos. Brown

To Regulate a Watch

Add together the latitude, the correct altitude of the suns centre, & the Polar dist; from the half sum subtract the Sun's altitude & note the remainder — Then add the Co sect of the Polar dist, the Secant of the latitude rejecting the indexes, the Co sine of the half sum & the Sine of the remainder; half the sum of these four logarithms sought in the tables of Sines will correspond to the hour of the day in the hour column —

Lat 51°30 N Sun's azc 6°55 S. Suns correct central altit° = 13°41' Required the time of observation? ——

⊙'s alt	13° 41'			
Lat	51 30	sec	0.	20585
P Dt	96 55	cosec	0	00317
Sum	162 06			
½ Sum	81 03	co sin	9.	19193
⊙'s alt	13 41			
remar	67 22	Sine	9.	96520
		Sum	19.	36615
hours 3 50 32" PM		Sine	9.	68307
or 8 9 28 am				

To find the latitude by one Altitude of the Sun having your watch previously equated.

Add together the co sine of the latitude by account, the the Co sine of the declination. the logarithms in the colm° of rising corresponding to the time from noon when the observation was taken (rejecting 20 in the index;) the Natural number of their sum added to the N Sine of the observed altitude will give the N Sine of the meridian altitude; from which the latitude is found in the usual manner ——

At Sea in latitude by account 60° N. when the sun was on the equator at 1h 0m Pm per watch well regulated. The suns alt was 28° 53' to South of me. What was the true Latitude

Lat 60° N Co sine 9. 69897
Dec " " " " 10 00000
Time from noon 1h 0m 0s 3.53243
1703 N num 3.23140

Sine 48303 obs alt 28° 53
N Si 50006 mer alt = 30°

90° "
mer alt 30 "
Z D 60 N
Dec " " "
Latt 60 " N

To find the apparent time by the Sun's Altitude
Find the ships latitude & longitude by account at the time of observation by carrying the reckoning forward to that time. With a Quadrant well adjusted take the altitude of the suns lower limb to which add 12m (for the Semidiameter & dip) & subtracting the refraction the remainder will be the apparent altitude, which subtracted from 90° gives the Zenith Distance
Find the suns corrct declination at the time of observation & if the latitude & declination be both of one name subtract the declination from 90° & you will have the Polar Dist. but if contrary names add the declination to 90° agues.
Add The Zenith distance
The Co latitude &
Polar distance into one sum. From half this sum subtract the Zen Dist & note the half sum & remr
Then add Log co sec of the co lat
Log co sec of the Polar Dist } rejecting the indexes
Log sine of half sum
Log sine of the remainder. & ~~sum half this sum~~
~~subtract the Zenith dist~~

And half the sum of these four logarithms, being found among the Co sines corresponds in the adjoined column to the time of day, forenoon or afternoon, according as it is marked A.M. or P.M.

Note The odd seconds may be neglected in finding the log. thims taking them for the nearest minute—

Suppose in the forenoon of 11th October 1804 Sea amount in Latt 51° 30' N. Long 62° E, the altitude of Suns lower limb should be found as under, required the apparent time?—

Times		Altitudes	
20	14	12°	28'
20	19	13	20
20	30	14	51
3) 61	03	40	39
mean 20	21	13	33
	add		12
		13	45
Sub refrac			4
true alt		13	41
Zen dist		76	19
Co lat		38	30
P Dist		96	55
Sum		211	44
½ Sum		105	52
Z dist		76	19
remainder		29	33

Odd 10th 5 a. 20h 21m is Odd 10th 20h 21m by Ephm & therefore wants 3h 39m of noon

Odd 11th by Ephmes

Suns dec at noon by Eph 11th — 7° 2' 15

Corr for long 62° E sub 3' 45"

Corr for time 3h 39' sub 3' 26 — 7 11

Suns Corr declination 6 55 4

90

Polar dist 96 55

Lat 51° 30'

90

38 30 Co lat

Co sec ——— 0. 20585

Co sec ——— 0. 00317

Sine ——— 9. 98313

Sine ——— 9. 69301

2 ⟌ 19. 88516

9 94258 Cosines

Corresponding to which in column marked AM is the true time of day 8h 9m 28 sec

8 21 " per watch

Watch 11 32 too fast

Thomas R Brown, U S Navy

Lunar Observations

To work a Lunar Observation without a Chart

1 Turn your longitude into time, & add it to the time at ship if in W long. but subtract it if in East. the sum or difference will be the supposed time at Greenwich which call reduced time.

2 Page 7 of the month in the Naut Alm, take the D^s Semi-diameter for the nearest noon & midnight to your reduced time find the difference, & add or subtract a proportional part for your reduced time according as it is increasing or decreasing. that is to say if the Semidiameter for noon is greater than the midnight the subtract the prop part from the Semidiameter for noon & the contrary, the sum or difference will be the moons ~~true~~ corrected Semidiam^r to which add the correction for augmentation answering to the moons altitude the sum will be the moons true Semidiameter

3 If the altitude of the Sun or moons lower limb be observed add 12m (the diff between the Semidiameter & dip) the sum will be the app altitude sufficiently exact-but if the upper limb be observed subtract 20m (the sum of the Semidiameter & dip) the remainder will be the app alt.

4 The Star's apparent altitude is always found by subtracting 4m (the dip) from the observed altitude-

5 Take from Page 7^th of the month in the Naut alm the proportional log of the moons hor par for the nearest noon & midnight to your reduced time & take their difference a prop part of this diff in the left hand side column of the table in Ham Moore with your reduced time at top the number answering thereto must be

applica as in the 2d Article & you will obtain the Prop log of the true hor par at the mean time, increase its index log 10, & from that sum subtract the Co sine of the moons app altitude the remainder will be the prop log of the parallax in altitude find the min & sec answering to this log & subtract from it the moons refraction, this last remainder will be the correction of the moons altitude

6 The Correction of the Suns altitude is found by subtracting the parallax from its refraction —

7 The Stars refraction is its correction of its altitude

8 If the Sun & moon are the bodies whose distance is observed the nearest limbs are always brought in contact, therefore to the observed distance add both the true semidiameters the sum will be the app distance.

9 When the moon & a star are the bodies the distance is observed it will sometimes happen that the hollow side of the moon (☾ *) will be next the star in which case the moons farthest limb must be brought in contact with the star, & then from the observed distance subtract the moons true semidiameter, & you will have the app distance. And the contrary when the illuminated limb is next the star. The Suns S D is found in page 3 of the month in Na

10 The Zenith distance of each body is found by subtracting the app altitude from 90 degrees — Then add

App dist of centres
The D's app Zen dist &

The ☉ or *'s app Zen dist. from half this sum subtract the moons Zen dist & call the remainder A — Also from the said half sum subtract the Sun or Stars Zen dist & call the remainder B. Then add the following 4 Logarithms together

Correction of the Sun or Star alt — D Log
App dist of centres ——— Sine
half Sum ——— Co Sect
⊙ or ☆ Zen dist ——— Sine
Quantity A ——— Co Sect. the

Sum of these log rejecting 10 from the indexes will be the P Log of the first correction which will always be added

Add together

Correction of the moon's alt ——— D Log
App dist of centres Sine
Moons Zen dist Sine
half sum ——— Co Sect
Quantity B ——— Co Sect the

Sum of these logs rejecting the 10 from the index will be the P Log of the 2 Correction & will be subtractive —

Having found these corrections, to the app dist add the first correction, & the correction of the moon's altitude & from that Sum subtract the 2nd Correction & the correction of the Sun or Star's altitude, the remainder will be the distance twice corrected for the effect of parallax & refraction

Take the difference between the correction of the moon's altitude & second correction, with that enter the table 18th & under the dist corrected take out the number of seconds corresponding, & in the same column opposite the correction of the moon's altitude take out the number of seconds corresponding, the difference of these two numbers is a number of seconds to be added to the corrected distance, when less than 90 Degs. but subtractive when above 90 Degs. the Sum or difference will be the true distance —

From the P Log of the correction of the ⊙ ☽ or ☆'s altde subtract 3010 (the common log of number 2) & call the remainder the D Log of the correction ——

To find the longitude from the true distance

In the Naut Alm among the distances of the objects look for the computed distance between the moon & other observed object for that given day, if it is found there, the time at Greenwich will be found at the top, but if it falls between them as it generally will, take the difference between the distances that stand immediately before & after the computed distance & also the distance standing before it & the computed distance.

Then from tab 23d take the Plogs of the first found difference & the Plog of the second found difference, & the difference between these two logs will be the Plog of a number of hours, m & secs, which being added to the time standing over the first distance in the N A. will give the true time at Greenwich, The difference between this Greenwich time & time at Ship turned into degrees by tab 19th will be the longitude of the place of observation which will be East if the time at Ship be greater than that at Greenwich, but if less it will be W. long—

Note The Character ☉ is for the Sun. ☽ for moon. ✱ for star

☽ ✱ or ✱ ☾ signifies the nearest limbs were observed, but

☾ ✱ or ✱ ☽ signifies the moons farthest limb was observed

L L. for lower limb. U L for upper limb; S D semidiameter. P L proportional logarithm. D L double logarithm N A nautical Almanac. Z D Zenith distance—

February 19th 1804 S A. the dist of the farthest limb of the moon & star Regulus was observed 76° 36' altitude ☽ L L 86° 28' alt ✱ 14° 13' apparent time of observation 6h 28m P M longitude by account 115° W. Required the true longitude?—

Feb 19th S a
is the 18th N a at } 6h 28'
Long 115° W in time 7 40
nance [illegible] 14 08 or
2h 8 min after mianight—

D S D at mia 16' 3"
noon 19th 15 59
Diff 4
prop pt 1
corrtd S D 16 2
aaa augmtn 16
true S D— 16 18

D's P L at mia 4853
noon 4867
14
2
10. 4855
Co si D alt } 8 7645
86° 40' }
D's par 3'25" P L 1. 7210
refc 3
Corr 3 22 D's alt

obs alt D's L L - 86° 28'
aaa 12
app alt 86 40
D's Zen dist 3 20
obs alt * - 14° 13
Sub 4
app alt 14 9
*'s Zen dist 75 51

obs dist 76° 36' "
D's S D " 16 18
app dist 76 19 42
D's Z D 3 20
*'s Z D 75 51
Sum 155 31
½ Sum 77 46
D'Z D 3 20
A 74 26
½ Sum 77 46
*'s Z D 75 51
B 1 55

app alt 76° 19' 42"
1st Cor 7 26
Cor D'alt 3 22
76 30 30
2d Cor: 3'54 7 37
Cor alt 3 43
true alt 76 22 53

The stars refraction 3'43" is its correction in altitude — —

" Corr * 's alt " 3' 43" D L 1. 3841
" app dist 76 20' " Sin 9. 9875
*'s Z D 75 51 " Sin 9. 9866
½ Sum 77 46 " C sec 0. 0100
A 74 26 " C sec 0. 0162
1st Cor 7" 26" = P L 1. 3844

Cor D alt " 3' 22" D L 1. 4270
app dist 76 20 " Sin 9. 9875
D'Z D 3 20 " Sin 8. 7645
½ Sum 77 46 " Co sec 0 0100
B — 1 55 Co sec 1. 4756
2d Cor 3' 54" = P L 1 6646

dist at mid 77° 48' 38
15h 76 4 37
1st diff 1 44 1 P L 2378
at mid 77 48 38
true at 76 22 53
2d diff 1 25 45 P L 3220
h m Sec P L 842
2 28 17 =
time at first dist 12
= 14 28 17 time at Green

14 28' 17" Greenwich
6 28 " at first
8 0 17 long in time
equal to 120° " W long

To find the correction for refraction by the Lunar Chart Published by Peter Delamar

Definition

It is easy to observe that this Chart consists of three sorts of lines; Viz. Parallel lines running from right to left as you place it before you; Perpendicular lines crossing them at right angles; & Oblique curve lines which cut both the former — Rules

Place the Chart before you, then find the greater altitude at the bottom of tab 1st among the perpendicular lines & the lesser altitude at the left hand side among the parallel lines; mark the point where they meet, this point reckoned among the obliqued curved lines will shew a logarithmic number consisting of three places of figures whose index is 2. (as may be seen at the top of the table) to this number add the cosect of the app.t dist. rejecting 10 from the index & you will obtain a common log, to find the number answering to this log, to which apply the number that stands opposite the distance in tab 2d according to the direction there given, & you will find a number of seconds which being brought to minutes will be the correction for refraction —

When the two altitudes will not meet in Tab 1, then neither Tabs 1 or 2 can be used, but in place of them use Tab 3. Viz Enter the table with the app.t dist in the column marked D. & opposite thereto in the column marked cor you have the correction in seconds, which must be brought to minutes & will always be additive

greater alt 60°24'. lesser alt 12°26', app.t dist 57°16

required the correction for refraction per Lunar Chart P.

2. 375

Co sec dist 0 075 add

2. 450 = 282 Num

71 sub

60) 2 11

3 31 sec Correction for refraction

To Work a Lunar Observation with the Chart

1st Method

Having found the app alts. app dist. app Zen dists of the two bodies, as before. Add together

App dist of centres

D's app Zen distance

⊙ or *'s app Zen dist; from half this sum subtract the Sun or star's Zen dist, & note the half sum & remainder

Then add D's Hor par Plog

D's app alt Sect, their sum rejecting 10' from the index will be the Plog of the first correction & will be additive.

From the Plog of the moons hor par subtract 3010 (the com log of number 2) & call the remainder the Dlog.

Then add Moon's hor par Dlog

App dist of centres Sine

Half sum Co sec

remainder Co sec. the sum of these four logarithms rejecting the 10' from the index will be the Plog of the second correction & will be subtractive.

May 18th S acct Long by acct 53° W. at 6h PM. dist ⊙ ☾ 63° 50' 19". alt ☾ L 41° 20'; alt ⊙ L 44° 48'. required the true longitude

May 18th 1800. S.A. is the 177th for N.A. at 6h 0m PM

Long 53° W in time —— 3 32

reduced time —— 9 32

D's SD at noon 15' 15" ☽ obs alt ☌ ☾ 41° 20 obs dist 63° 50' 19"
mid 15 10 sub 20 D's SD " 15 21
diff " 5 app alt 41 " ☉'s SD " 15 51
prop pt 4 D's Zen dist 49 " app dist 64 21 31
corrected SD 15 11 ☉'s obs alt 44 48 D Z D 49 " "
add augmtn 10 add 12 ☉'s Z D 45 " "
true SD 15 21 app ~~dist~~ alt 45 " Sum 158 22
D's hor par noon 55' 59 ☉'s Zen dist 46 " ½ Sum 79 11
mid 55 40 ☉ Z D 45 "
diff 19 34 11 remainder
Prop pt 15 PL 0.5091
true hor par 55 44 Dlog 0.5091 sub 3010
D's app alt 41° " Sine 0 1222 Dlog 2081
1st Cor 42' 4" = PL 6313
Hor par ——— Dlog 0.2081 app dist 64° 21' 31"
app dist 64° 22' Sine 9.9550 Cor ☾ Ct " 1 10
½ Sum 79 11' Cosec 0 0077 1st Cor " 42 04
remar 34 11' Cosec 0.2503 65 44 45
2d Cor 1° 8' 16" = PL 0.4211 2d Cor 1 08 16
63 56 29
By Ephm dist ☾ 64° 11' 6" 3d Cor 4
12 62 45 8 true dist 63 56 33
1st diff 1 25 58 Plog 3209
dist ☾ 64 11 06
true dist 63 56 33
2d diff " 14 33 PL 1.0925
hour 0 30 27" = PL. 7716
9
Time at Greenwich 9 30 27
at Ship 6 " "
Long in time 3 30 27 or 52° 27" W

2nd Method Per Chart

Having found the app alts. app dist, ~~app dist~~ & moons hor par as before directed, the effect of the moon's parallax may be found as follows

Moons Hpar	——	Plog	Moons Hpar		Plog —
app dist		Sine	app dist		tan —
☉ or ✶ app alt		Cosec	D's app alt		Cosec —
1st Anth	=	PL	2d Anth		Plog

If the app dist be more than 90 Degs the sum of the two Anths

will be the effect of parallax & will be subtractive —
If the app dist be less than 90° & the first Alt greater than the 2nd, their diff will be the effect of parallax & will be subtractive
If the app alt be less than 90° & the first Alt less than the 2nd their diff will be the effect of parallax & will be additive —
June 17th 1800 S Acct 6h 30m PM. Long 105° W by Acct. dist of ☉ & ☾ 57° 17' 16" alt ☾'s UL 40° 34' alt ☉'s LL 28° 20' required the true longitude —

June 17th S a is 16h per N a at 6h 30 PM

Long 105° W in time 7 "

reduced time 13 30 or 1h 30 am

D's S D at mia	16h 14' 53	D's Obs alt UL	40° 34	Obs dist	57° 17' 16
noon	17h 14 50		20	D S D	" 15 02
diff	" 03	D app alt	40 14	☉ S D	" 15 47
prop pt	1	☉'s Obs alt LL	48 20	app alt	57 48 05
corrd S D	14 52		12		
add augmt	10	☉ app alt	48 32		
true S D	15 02				
D to Par mid	54 37				
noon	54 27				
Dff	10				
prop pt	2				
true Hor par	54 35	PL	0.5182	app dist	57° 48' 05
app dist	57° 48	Sin	9.9274	eff par	26 09
☉ app alt	48 32	Sec	0 1253		57 21 56
1st Alt	48' 21"	PL	5709	Corr CC	1 03
Hor par	54' 35".	PL	0.5182		57 22 59
app dist	57° 48	tan	0.2008	3d Cor	6
D app alt	40 14	Sec	0 1898	true dist	57 23 "5
2d Alt	22' 12" =	PL	0 9088		
1 Alt	48 21				
eff par	26 09				

By Epm dist at 12h 58° 4' 41"

	15 56 42 30		
Dff	1 22 11	PL	3405
12h	58 4 41		
true dist	57 23 5		
diff	41 36	PL	6362
hour	1h 31' 7"		2957
	12		
	13 31 7	at Greenwich	
	6 30	at Ship	

7h 1' 7" long in time = 105° 17' W

3d method per Chart

Having found the appalts, the appdist of centres, the apt Zen dist, moons hor par, as before, The effect of the moons parlx on the distance may be found as follows —
Find half the sum, & half the differences ~~betw~~ of the two Zen distances Then aaa

Half sum	—	Tan
Half diff		Tan
Half appdist		Co tan. Their sum reject

ing 20 from the index will be the Tan of an Arch which call A.

If the moons ZD excess the sun or stars aaa A & half the appdist together, otherwise take their difference the sum or remainder will be the moons Segment

Then aaa	D's Segment	Co tan
	D's appalt	Co sect
	D's Hor par	P log Their sum

rejecting 10 from the index will be the PL of the effect of moons parallax. When the Arch A is greater than half the appdist & the moons ZD is less than the sun or star then the effect of parlx found as above will be additive but in all other cases subtractive.

March 9th 1800 SA Longbeyant 60 E made the following obs.

Times			Dist ✱ ☽			alt ☽ LL		alt ✱ Spica	
h	m	sec							
8	17	20	66°	41'	20"	44°	06	19°	52'
8	18	25	66	42	25	44	14	20	01
8	19	15	66	43	15	44	28	20	13
3) 24	55	00	200	07	00	132	48	60	06
mean 8	18	20	66	42	20	44	16	20	02
PM			DSD	15	52		12		4
			aD 66	26	28	apa 44	28	apa 19	58
			33	13	14	ZD 45	32	ZD 70	02
			½ app dist						

march 9th S a is the 8th per Naut alm at 60° E longitude in time is — —

reduced time

8h 18' 20"
4
4 18 20

D's S D at noon 15'39 hor par noon 57'27
mid 15 46 — — — 57 51
aff 7 aff 24
prop pt 2 prop pt 8
15 41 true Z D par 57 35
add augmt 11
true S D — 15 52

D Z D 45° 32
* Z D 70 2
Sum 115 34
½ sum 57 47
aff Z D 24 30
½ diff 12 15

½ Sum 57° 47 tan 10.2005
½ aff 12 15 tan 9.3367
½ ap alt 33 13 Ctan 10.1838
Arch A 27° 45' = Tan 9.7210
½ ap diff 33 13
D's Segmt 5 28

D's Segmt 5° 28 C tan 1.0190
D ap alt 44 28 C sec 15'46
D hor par 57' 35" P L 4950
effect parlx 3'52 P L 1.6686

diff par 3 52
66 22 36
Con L Ct 1 49
66 24 25
3d Corr 6
true diff — 66 24 31

ait at 3h 67° 8 24
6h 65 28 19
1 40 05 P L 2549
3h 67° 8 24"
true d 66 24 31
43 53 P L 6130
1h 18' 55 = 35'81
3
4 18 55 at Greenwh
8 18 20
long in time 3 59 25 or 59° 52 E

Worked by 1st method per Chart

March 31st 1804 S a at 3h 48m am. Long by ast 155° W. diff D — * Fomalhaut 80° 48' 3" alt * 23° 59' ☉ L 55° 36' required the true long.

march 31 S a is 30th per N a at 3h 48
Long 155 W in time 10 20
reduced time 14 08
or 2h 8m —

D's S D at noon 14 50
mid 14 53
diff 3
14 50
13
true S D 15 03

D hor par noon 54'26
mid 54 36
10
2
true hor par 54 28

D's obs alt L L 55° 36
12
ap alt 55 48
D Z dist 34 12
* obs alt 23 59¼
ap alt 23 55
* Z dist 66 5

½ Sum 90° 40 | 66 5 | 24 35 | mean
* Z D | 23 55 | 66 5
obs alt 80° 48' 3" | 15 3 | 65 —
D S D | 15 03 | 3 12 5 | 20
ap alt D | 81 | 34 12 | 40
D Z D | 3 6 — | 66 5
* Z D | 66 5
sum | 151 20
½ Sum | 90 40

D's hor par 54' 28" PL 0.5191 — app alt 81° 3' 6"
D app alt 55° 48 sec 0.2502 — 1st Cor 30 37
1st Cor 30' 37" = PL 0 7693 — Corr L Ct 2 8
D hor par ——— DL 0.2181 — 81 35 51
app alt 81° 3' Sin 9.9947 — 2d Cor 45 52
½ sum 90 40 Csc 0 0000 — true alt 80 49 59
remar 24 35 Csc 0 3809
2d Cor 45' 52" = PL 0.5937

By Ephm alt at 12h — 81° 39' 18"
15h — 80 17 07
diff 1 22 11 PL 3405
12h 81 39 18
true alt 80 49 59
49 19 PL 5623
hour 1 48 0 PL 2218
12
Time at Greenwich 13 48 "
Ship 3 48
Long in time 10 " or 150° West

Same example worked by 2nd Method per Chart
*app alt 23° 55' D app alt 55° 48. app alt 81° 3' 6" PL D's Hor par 5191. Corr L Chart 2' 8" ——

D's Hor par ——— PL 0 5191 = 0.5191
app alt 81° 3' Sine 9.9947 — app alt 81° 3' tan 0.8027
*ap alt 23 55 Csc 0 3921 — D ap at 55° 48 Csc 0.0825
1st Arch 22' 21" = PL 0.9059 — 2d arch 7' 6" PL 1.4043
2nd " 7.6
Effect of 15 15 par in

app alt 81° 3' 6"
Eff par 15 15
80 47 51
Corr L C 2 8
true alt = 80 49 59 agreeing exactly

with the former method

Again repeated by 3d Method per Chart ——

☽ ZD 34° 12 ½ sum 50° 8 tan 10.0782
* ZD 66 5 ½ diff 15 57 tan 9.4561
sum 100 17 ½ apat 40 32 6 tan 10.0680
½ sum 50 08 Arch A 20° 49′ tan 9.6023
diff ZD 31 55 ½ apat 40 32
½ diff ZD 15 57 D^s Segmt 18 43 Co tan 0.4701
app alt 81° 3′ 6 apalt 55° 48 Co sec 0.0825
½ ap alt 40 31 33 D^s Z Chan —— PL 5191
Offset par 15′ 15″ PL 1.0717
app alt 81° 3′ 6
Off par 15 15
80 47 51
Corr Lct 2 8
true dist 80 49 59 agreeing with the two former methods ——

Another method of working a Lunar observation without a Chart — First
Add the sun or stars & moons apparent altitudes together & take half their sum & half their difference. Then add
½ sum Co tan
½ diff tan
½ app dist Co tan. Their sum rejecting 20 in the index will be the tan of an angle which call A —
2d When the sun or stars altitude is greater than the moons, take the diff between & half the app dist, but if less take the sum — Then add
This sum or diff Co tan
Cor ☉ or * app alt Co tan
Correction ☉ or * alt Phy. their sum rejecting 20 from the index will be the PL of the 1st Correctn
3d If the sum of angle A & half app dist was taken in the last article take now the diff, & vice versa

Then add. This sum or diff — Co tan
D's app alt — Co tan
Cor D's alt — P L to their sum
rejecting 20 from the index will be the P L of the 2d Cor
4th When the Angle A is less than the half app diff the first correction must be added to & the 2d Correction subtracted from the app diff — but when angle A is the greatest their sum must be added to the app diff if the ☉ or ☆ alt is less than the moon's, but if the moon is the least their sum must be subtracted to give the correct distance. To this apply the correction found in tab XVIII for the true distance

July 13th 1800 Sa at 9h 30m PM. diff ☾ ☆ aldebaran
57° 31′ 15″ alt ☾'s L L 60° 12′. alt ☆ 12° 30′ Long by ast 30° 2

July 13th Sa is 12th Na at 9h 30 — obs diff 57° 31′ 15

Long E	30° —	2 "	D's S D	15 27
reduced time		7 30	ap alt	57 15 48
			p/r ap diff	28 37 64

D S D noon 15′ 17 — D L L 60 12′

mia		15 11		12
				60 24
p diff		6	3 D	29 36
p tab		4	☆ alt	12 30
		15 13		4
add aug		14		12 26
true S D		15 27	3 D	77 34

D P L noon 5065

D app alt	60 24			
☆'s		12 26		
sum		72 50		
p/r sum		36 25		
Diff		47 58		
p/r diff		23 59		

	5093	p/r sum 36° 25 Co tan	10. 1321
	28	p/r aff 23 59 ☆	9. 6482
	19	p/r ap at 28 38 Co ☆	10. 2628
		Ang A 47° 51′ = tan	1. 0431
Co ☆ D alt 60 24	10. 5084		
	- 9 6937	p/r ap at 28 38	
p cor in 27′ 35	P L 8147	sum 76 29 Co tan	9. 3809
1st p cor	33	☆'s ap alt 12 26 Co tan	10 6566
Cor D	27 2 alt	Cor ☆ alt 4′ 12″ P L	1. 6286
		1st Cor 3′ 53″ = P L	1. 6661

Diff bet ang a & p appt - 19° 13' Co tan 10.4577
D^s app alt 60 24 Co tan 9.7544
Con D^s alt 27' 2" PL 0.8234
2^d Con 16' 35 = PL 1.0355

app^t	57°	15'	48	By Ephm	6^h	58°	24' 7"
1^st Con	"	3	53		9	56	52 3
2^d Con	"	16	35	diff		1 32	40 PL 2912
	57	36	16		6^h	58°	24 7"
3^d Con			3	true alt		57	36 19
true alt	57	36	19			47	40 PL 5758

hour 1^h 33' 28" = PL 2846
add 6
time 7 33 28 at Greenwich
9 30 at ship
long in time 1 56 32 or 29° 8' E

Thomas
Brown

Days on

Days of Week	Days of the m.	Course	Dist	Diff Lat	Dept	meridional Distance	Latt Obsd	Latt DR	Diff Lat	Dep	Wind	Leeway	Currents & Leave of the Sea
	may										pts		
Wednesday	12th	S 85° W	76"	7"	75"	1°.15"	35°.41"	35°.41"	1	7°.21"	1/2	"	"
Thursday	13	N 87 W	69	4	67	2.22"	35.45	35.45	1.23	8.44	1/2	"	
Friday	14	S 61 W	157	76	138	4.40	34.29	34.29	2.48	11.32	1/2	"	SSE2 kph
Saturday	15	S 58 W	150	79	129	6.49	33.10	33.10	2.34	14.06	1/2	"	" 1/4ph
Sunday	16	S 47 W	92	63	66	8.55	32.07	32.07	1.19	15.25	1/2	"	1/4kph
Monday	17	S 79 W	36	7	35	8.59	32.01	32.60	.42	16.07	1/2	"	24h
* New Departure Tuesday	18	S 83 W	70	9	71	1°.11"	32.21	32.21	1.24	18.10	1/2	"	13m 24h
Wednesday	19	N 81 W	66	10	65	2.16	32.31	32.31	1.17	19.27	1/2	"	16m 24h
Thursday	20	N 42 W	130	97	86	3.42	34.11	34.08	1.42	21.09	1/2	3/4	—
Friday	21	N 17 W	70	67	20	4.02	35.21	35.18	.35	21.44	1/2	1/2	—
Saturday	22	S 48 W	124	93	84	5.26	33.48	33.48	1.41	23.25	1/2	3/4	12 SSE. kph
Sunday	23	S 62 W	58	27	51	6.17	33.21	33.21	1.01	24.26	1/2	—	—
Monday	24	S 11 W	77	75	11	6.28	32.6	32.06	.26	24.52	1/2	1/2	—
Tuesday	25	S 28 W	74	65	34	7.2	31.1	31.01	.40	25.32	1/2		—
Wednesday	26	S 78 W	112	110	24	7.26	29.9	29.11	.28	26.00	1/2		—
										26.30			

Course Steered June 12th 1862 Winds Leeway & Currents of the Sea

16 8 "
11 8 "
12 6 "

Variation Abstract